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Editor

105

AS Elevation Contours over the C/INFO Generate Format

and J. Nickeson

Aeronautics and
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Space Flight Center
Maryland 20771

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**Technical Report Series on the
Boreal Ecosystem-Atmosphere Study (BOREAS)**

Forrest G. Hall, Editor

Volume 105

**BOREAS Elevation Contours over the
NSA and SSA in ARC/INFO Generate Format**

*David Knapp and Jaime Nickeson, Raytheon ITSS,
NASA Goddard Space Flight Center, Greenbelt, Maryland*

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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BOREAS Elevation Contours over the NSA and SSA in ARC/INFO Generate Format

David Knapp, Jaime Nickeson

Summary

This data set was prepared by BORIS Staff by reformatting the original data into the ARC/INFO Generate format. The original data were received in SIF at a scale of 1:50,000. BORIS staff could not find a format document or commercial software for reading SIF; the BOREAS HYD-08 team provided some C source code that could read some of the SIF files. The data cover the BOREAS NSA and SSA. The original data were compiled from information available in the 1970s and 1980s. The data are available in ARC/INFO Generate format files.

Note that the files of this data set on the BOREAS CD-ROMs have been compressed using the Gzip program. See Section 8.2 for details.

Table of Contents

- 1) Data Set Overview
- 2) Investigator(s)
- 3) Theory of Measurements
- 4) Equipment
- 5) Data Acquisition Methods
- 6) Observations
- 7) Data Description
- 8) Data Organization
- 9) Data Manipulations
- 10) Errors
- 11) Notes
- 12) Application of the Data Set
- 13) Future Modifications and Plans
- 14) Software
- 15) Data Access
- 16) Output Products and Availability
- 17) References
- 18) Glossary of Terms
- 19) List of Acronyms
- 20) Document Information

1. Data Set Overview

1.1 Data Set Identification

BOREAS Elevation Contours over the NSA and SSA in ARC/INFO Generate Format

1.2 Data Set Introduction

This vector contour data set was prepared by BOREal Ecosystem-Atmosphere Study (BOREAS) staff by reformatting the original data into the ARC/INFO Generate format. These data cover portions of the BOREAS Northern Study Area (NSA) and Southern Study Area (SSA) and are on a scale of 1:50,000.

1.3 Objective/Purpose

These data are provided as part of the BOREAS Staff Science Geographic Information System (GIS) Data Collection Program, which included the collection of pertinent map data in both hardcopy and digital form. The purpose of these data is to provide the user with elevation contours of the Modeling Sub-Areas (MSAs). These data can be used to create Digital Elevation Models (DEMs) of the MSAs. The original Standard Interchange Format (SIF) data were reformatted to the ARC/INFO Generate format because it was considered difficult for an average user to extract the contours from the SIF files.

1.4 Summary of Parameters

The parameters that are in the reformatted data are the elevation of the contour (meters above mean sea level) and North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) coordinate pairs (easting and northing) along the contour.

1.5 Discussion

Based on information available to BOREAS Information System (BORIS) personnel, these data were manually digitized from the National Topographic System (NTS) map sheets at a scale of 1:50,000. The data were given to BORIS staff in SIF and K8A (the meaning of K8A is unknown) formats. C source code provided by the BOREAS Hydrology (HYD)-08 team was modified to read the contour data from various files. The input data were understood to be in a standard format, but they were not standard in terms of the software's ability to consistently read all of the data files.

1.6 Related Data Sets

BOREAS HYD-08 DEM Data over the NSA-MSA and SSA-MSA in the UTM Projection

2. Investigator(s)

2.1 Investigator(s) Name and Title

David Knapp
BORIS Staff Member

2.2 Title of Investigation

BOREAS Staff Science GIS Data Collection Program

2.3 Contact Information

Contact 1:

David Knapp
Raytheon ITSS
NASA GSFC
Code 923
Greenbelt, MD 20771
(301) 286-1424
David.Knapp@gsfc.nasa.gov

Contact 2:

Jaime Nickeson
Raytheon ITSS
NASA GSFC
Code 923
Greenbelt, MD 20771
(301) 286-3373
Jaime.Nickeson@gsfc.nasa.gov

3. Theory of Measurements

These data were not collected with any particular research in mind.

4. Equipment

4.1 Sensor/Instrument Description

Unknown.

4.1.1 Collection Environment

Unknown.

4.1.2 Source/Platform

Unknown.

4.1.3 Source/Platform Mission Objectives

The implied purpose of the NTS 1:50,000-scale map sheets was to provide users with needed location and topographic information.

4.1.4 Key Variables

Elevation above mean sea level NAD83 UTM coordinate pairs.

4.1.5 Principles of Operation

Unknown.

4.1.6 Sensor/Instrument Measurement Geometry

Unknown.

4.1.7 Manufacturer of Sensor/Instrument

Unknown.

4.2 Calibration

4.2.1 Specifications

Unknown.

4.2.1.1 Tolerance

Unknown.

4.2.2 Frequency of Calibration

Unknown.

4.2.3 Other Calibration Information

None.

5. Data Acquisition Methods

The data were acquired from the National Topographical Data Base and received from the Canadian Centre for Remote Sensing (CCRS). The original data came in SIF, digitized from 1:50,000-scale topographic maps.

6. Observations

6.1 Data Notes

None.

6.2 Field Notes

None.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The various data files cover parts of the BOREAS NSA-MSA and SSA-MSA. The two areas that are covered by these vector files include an area west of Thompson, Manitoba (NSA), and an area north of Prince Albert, Saskatchewan (SSA). Each of the following maps covers an area roughly 31.5 km x 27.8 km. The following NTS map sheets are covered by the data:

For the NSA:

Number	Name
63 O/10	Wuskwatim Lake
63 O/15	Nelson House
63 O/16	Noble Lake
63 O/09	Ospwagan Lake
63 P/14	Begg Lake
64 A/03	Orr Lake
64 A/04	Strong Lake
64 B/01	Harding Lake
64 B/02	Leftrook Lake

For the SSA:

Number	Name
73 G/09	Halkett Lake
73 G/16	Waskesiu Lake
73 H/09	Torch River
73 H/10	Bedard Creek
73 H/11	Birchbark Lake
73 H/12	Emma Lake
73 H/13	Bittern Lake
73 H/14	Candle Lake
73 H/15	White Gull Creek
73 H/16	Falling Horse Creek
73 I/01	Scarth River
73 I/02	Summit Lake
73 I/03	Whiteswan Lake
73 I/04	Montreal Lake South
73 J/01	Crean Lake

The area covered by these sheets does not cover all of the area described by the following NAD83 bounding coordinates. These bounding areas are provided to give a general idea of where these map sheets fall.

	NSA-MSA	
	Longitude	Latitude
	-----	-----
Northwest	98.72W	56.055N
Northeast	98.09W	55.990N
Southeast	98.18W	55.726N
Southwest	98.81W	55.790N

	SSA-MSA	
	Longitude	Latitude
	-----	-----
Northwest	105.18W	54.093N
Northeast	104.42W	54.053N
Southeast	104.48W	53.695N
Southwest	105.23W	53.735N

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

The original contour interval of the data is 25 feet (7.62 m).

7.1.4 Projection

The data are in their original UTM projection. The NSA data are in UTM zone 14, and the SSA data are in UTM zone 13.

7.1.5 Grid Description

Quantitative estimates were not made of the mean spacing between points along the contour lines. Visual assessment of the data showed the spacing to be appropriate for the 1:50,000 scale (i.e., there was no noticeable jaggedness or discontinuities along the contours).

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Information regarding when the original source data were collected is sketchy. Most of the maps from which these contours were digitized were made in the 1970s or 1980s.

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

Although these data were likely compiled from map and aerial photograph vintages covering 10 or more years, they are considered to be a single reference data set.

7.3 Data Characteristics

7.3.1 Parameter/Variable

Elevation above mean sea level
NAD83 UTM coordinate pairs along a given elevation contour

7.3.2 Variable Description/Definition

Elevation above mean sea level - The vertical distance between a plane at mean sea level and a parallel plane intersecting this point. NAD83 UTM coordinate pairs along a given elevation contour - The NAD83-based UTM easting and northing coordinate pairs that define the geographic locations over which the given contour exists.

7.3.3 Unit of Measurement

Elevation above mean sea level - meters
NAD83 UTM coordinate pairs along a given elevation contour - UTM meters

7.3.4 Data Source

Geomatics Canada
Natural Resources Canada
615 Booth St.
Ottawa, Ontario K1A 0E9 CANADA

7.3.5 Data Range

NSA-MSA
Elevation
(meters)

Minimum: 206
Maximum: 381

SSA-MSA
Elevation
(meters)

Minimum: 335
Maximum: 747

7.4 Sample Data Record

442
533084.00, 5939891.00
533079.00, 5939891.00
533061.00, 5939889.00
533033.00, 5939897.00
532950.00, 5939902.00
532877.00, 5939910.00
532849.00, 5939918.00
532784.00, 5939950.00
532747.00, 5939991.00
532714.00, 5940015.00
532539.00, 5940100.00
END

8. Data Organization

8.1 Data Granularity

The smallest amount of data obtainable is the entire set of vector contour files.

8.2 Data Format(s)

8.2.1 Uncompressed Data Files

The vector contour data set consists of a set of 24 files in the following order:

File 1:	Data for Map 73 G/09	(400 bytes per record)	SSA
File 2:	Data for Map 73 G/16	(400 bytes per record)	
File 3:	Data for Map 73 H/09	(400 bytes per record)	
File 4:	Data for Map 73 H/10	(400 bytes per record)	
File 5:	Data for Map 73 H/11	(400 bytes per record)	
File 6:	Data for Map 73 H/12	(400 bytes per record)	
File 7:	Data for Map 73 H/13	(400 bytes per record)	
File 8:	Data for Map 73 H/14	(400 bytes per record)	
File 9:	Data for Map 73 H/15	(400 bytes per record)	
File 10:	Data for Map 73 H/16	(400 bytes per record)	
File 11:	Data for Map 73 I/01	(400 bytes per record)	
File 12:	Data for Map 73 I/02	(400 bytes per record)	
File 13:	Data for Map 73 I/03	(400 bytes per record)	
File 14:	Data for Map 73 I/04	(400 bytes per record)	
File 15:	Data for Map 73 J/01	(400 bytes per record)	
File 16:	Data for Map 63 O/09	(400 bytes per record)	NSA
File 17:	Data for Map 63 O/10	(400 bytes per record)	
File 18:	Data for Map 63 O/15	(400 bytes per record)	
File 19:	Data for Map 63 O/16	(400 bytes per record)	
File 20:	Data for Map 63 P/14	(400 bytes per record)	
File 21:	Data for Map 64 A/03	(400 bytes per record)	
File 22:	Data for Map 64 A/04	(400 bytes per record)	
File 23:	Data for Map 64 B/01	(400 bytes per record)	
File 24:	Data for Map 64 B/02	(400 bytes per record)	

The 24 data files each contain maximum record sizes of 400 bytes. Each physical record on tape consists of 1 to 10 logical records of 40 bytes each. As noted previously, the data in the files are stored in the ARC/INFO Generate format. Within each file, the data in the 40-byte logical records are stored as American Standard Code for Information Interchange (ASCII) characters. The records are arranged in groups that contain varying numbers of records. The first record of the group contains the value for the elevation above mean sea level. This is followed by the records containing the UTM easting and northing coordinate pairs for that elevation contour. At the end of each contour, a record containing the ASCII characters 'END' indicates the end of the contour. A second record containing the ASCII 'END' characters is given at the end of the contour groups to indicate the end of the file. The following listing illustrates this format.

```
442          <----- This is the contour's elevation (meters)
533084.00, 5939891.00  <----- This is the first of a series of UTM
533079.00, 5939891.00          coordinates (easting, northing) that
533061.00, 5939889.00          define the contour.
533033.00, 5939897.00
532950.00, 5939902.00
532877.00, 5939910.00
```

```

532849.00, 5939918.00
532784.00, 5939950.00
532747.00, 5939991.00
532714.00, 5940015.00
532539.00, 5940100.00
END <----- This marks the end of this contour.
465 <----- The elevation of the next contour.
531985.00, 5953858.00
531985.00, 5953866.00
531972.00, 5953881.00
531950.00, 5953891.00
531899.00, 5953894.00
531853.00, 5953913.00
531774.00, 5953915.00
531744.00, 5953899.00
...
531734.00, 5953875.00
531745.00, 5953826.00
531766.00, 5953808.00
END <----- This marks the end of this contour.
END <----- This marks the end of the file.

```

8.2.2 Compressed CD-ROM Files

On the BOREAS CD-ROMs, all the files listed in Section 8.2.1 have been compressed with the Gzip compression program (file name *.gz). These data have been compressed using gzip version 1.2.4 and the high compression (-9) option (Copyright (C) 1992-1993 Jean-loup Gailly). Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP programs. The compressed files may be uncompressed using gzip (-d option) or gunzip. Gzip is available from many Web sites (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

9. Data Manipulations

9.1 Formulae

The only data value conversion performed by BORIS staff was to convert the elevation measurements in feet in some (not all) of the files to meters. This was done by dividing the elevation values of feet by 3.28 and then rounding the result.

9.2 Data Processing Sequence

9.2.1 Processing Steps

BORIS staff processed the original data to the current product by:

- Attempting to read a file with the provided software
- Modifying the C source code and updating the file header to read the specific file
- Running the program to extract contours from the file and create output files
- Writing the output files to tape
- Copying the ASCII and compressing the binary files for release on CD-ROM

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

There appeared to be two types of files in the original set. In many cases, the header information in each file had to be modified in order for the modified software to extract the contours successfully.

9.3.2 Calculated Variables

See Section 9.1.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

One source of error is the digitizing process used to create the contours from the map sheets. It is not known whether the maps were hand digitized or if software was used to digitize the contours. In either case, the error is probably negligible.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Unknown.

10.2.2 Confidence Level/Accuracy Judgment

Unknown.

10.2.3 Measurement Error for Parameters

Unknown.

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

After extracting the data into the ARC/INFO Generate files, BORIS staff plotted the contour data and visually reviewed the data with the 1:50,000-scale hardcopy maps. No anomalies or errors were detected in this review.

11. Notes

11.1 Limitations of the Data

Because the data have a 25-foot contour interval, variations in the terrain that are smaller than 25 feet may not be detectable. The user should not expect to see terrain detail such as small berms or other minor topographic relief.

11.2 Known Problems with the Data

The NSA maps from which these data were derived were found to be in disagreement with BOREAS-gathered and differentially corrected Global Positioning System (GPS) coordinates by about 150 meters. The error did not appear to be systematic. The SSA maps have a higher degree of accuracy (about 45 meters) when compared to GPS.

11.3 Usage Guidance

If these data are going to be used to create a DEM, the various vector files should be edge-matched to create seamless contours that do not have discontinuities at the map boundaries.

Before uncompressing the Gzip files on CD-ROM, be sure that you have enough disk space to hold the uncompressed data files. Then use the appropriate decompression program provided on the CD-ROM for your specific system.

11.4 Other Relevant Information

None.

12. Application of the Data Set

These data can be used to create a gridded DEM of the area of interest as well as for graphical purposes, as an overlay along with other vector layers.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

C source code from HYD-08 was used for converting from SIF or K8A format. The software to read the SIF and K8A was originally produced by an unknown source, although it was obtained from HYD-08. The software reads the input file and extracts certain features based on feature codes that are supplied by the user.

Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP commands.

14.2 Software Access

The software is written in C and is operational on UNIX workstations at GSFC. The software is available by contacting the ORNL DAAC or BOREAS staff.

Gzip is available from many Web sites across the Internet (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

15. Data Access

The elevation contour data over the NSA and SSA in ARC/INFO Generate format are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics
<http://www-eosdis.ornl.gov/>.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [<http://www-eosdis.ornl.gov/>] and the anonymous FTP site [<ftp://www-eosdis.ornl.gov/data/>] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

The vector contour data can be made available on 8-mm, Digital Archive Tape (DAT), or 9-track tapes at 1600 or 6250 Bytes Per Inch (BPI).

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

Welch, T.A. 1984. A Technique for High Performance Data Compression. IEEE Computer, Vol. 17, No. 6, pp. 8-19.

17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102 (D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

ASCII	- American Standard Code for Information Interchange
BOREAS	- Boreal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
BPI	- Bytes Per Inch
CCRS	- Canadian Centre for Remote Sensing
CD-ROM	- Compact Disk-Read-Only-Memory
DAAC	- Distributed Active Archive Center
DAT	- Digital Audio Tape
DEM	- Digital Elevation Model
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
GIS	- Geographic Information System
GMT	- Greenwich Mean Time
GPS	- Global Positioning System
GSFC	- Goddard Space Flight Center
MSA	- Modeling Sub-Area
NAD27	- North American Datum of 1927
NAD83	- North American Datum of 1983
NASA	- National Aeronautics and Space Administration
NSA	- Northern Study Area

NTS	- National Topographic System
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
SIF	- Standard Interchange Format
SSA	- Southern Study Area
URL	- Uniform Resource Locator
UTM	- Universal Transverse Mercator
WWW	- World Wide Web

20. Document Information

20.1 Document Revision Date(s)

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20.2 Document Review Date(s)

BORIS Review: 06-Jun-1997

Science Review:

20.3 Document ID

20.4 Citation

When using these data, please include the following acknowledgement as well as citations of relevant papers in Section 17.2:

These data originated as vector data that were provided to BORIS staff through CCRS by Geomatics Canada. The contribution of the data by CCRS and Geomatics Canada and processing of the data by BORIS staff are greatly appreciated.

If using data from the BOREAS CD-ROM series, also reference the data as:

Knapp, D. and J. Nickeson, "BOREAS Staff Science GIS Data Collection Program." in Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

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